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10      **SYSTEM AND METHOD FOR ENABLING SIMULTANEOUS  
MULTI-USER ELECTRONIC DOCUMENT EDITING**

TECHNICAL FIELD

15                    The present invention relates to a system and method for enabling  
multi-user electronic document editing, and more particularly relates to a system  
and method for enabling simultaneous multi-user electronic document editing by  
managing the merging of changes of multiple users editing the same document at  
the same time.

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BACKGROUND OF THE INVENTION

Computer users desire the ability to permit multiple users to review  
and edit documents at the same time. However, in order to avoid the situation in  
25      which two users make conflicting changes to the same document, safeguards have  
been implemented to prohibit a second user from accessing a document that is  
currently opened by another user. This has been accomplished in the past by  
locking the document when it is being edited by any user and prohibiting  
subsequent attempts to open the document. Unfortunately, this solution does not  
30      provide for simultaneous multi-user review and edit of a particular document.  
Because only one user can open and edit the document at any given time, this

approach only provides for sequential multi-user editing. Simultaneous multi-user editing has been enabled through at least two other approaches.

One approach utilizes a central server process that permits users to merge local changes back into a shared copy of the document (the original document). Under this approach, when one user attempts to save changes to the document, the central server process attempts to store the user's changes to the original document. If the original document has been edited since the user opened its local copy, the user is notified of a potential conflict. Upon notification, the user can choose which version to store as the original document. Alternatively, the central server process can attempt to merge the changes in the user's local copy with the changes made in the modified original documents. Unfortunately, this approach is unacceptable to many users, because it requires the user to implement a central document repository for managing the document library. The repository may require a separate central server (or access monitor) to handle the requests for checking documents in and out of the repository. This process is consumptive of system resources and can slow user access to documents.

A second approach involves the use of a specialized file format that supports multi-user editing. For example, MICROSOFT EXCEL utilizes a special format referred to as a "shared workbook" that supports multi-user editing. Unfortunately, this approach is often unacceptable to users because a new file format may not be compatible with the user's earlier, non-multi-user file formats. Users are typically unwilling to utilize file formats that are not compatible with previously used file format. In addition, often the multiple user file format will have limited functionality as compared with non-multi-user file formats. That is, many of the special features of non-multi-user file formats will be disabled, because they tend to create more conflicts when changes are merged.

Therefore, there is a need for a means for enabling simultaneous multi-user editing that does not require a new file format and does not require a central server process.

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The present invention fulfills the need in the art for a simple and elegant means for allowing multi-user editing of an original document. The system and method provided by the present invention do not require the use of a new file format or the use of a central document repository.

If a determination is made that the document is in use, then an alert is presented to the user that informs the user that the document is locked for editing. The alert will also provide the user with three options. The user may select to open the document as a "read only" document. The user may select to open a document as a "local copy" and subsequently merge any changes into the original document. Finally, the user may select to receive a notification when the original document is no longer in use. If the user selects the first option, a read-only version of the document will be provided and the user may save the document under a separate filename and/or in a location other than that occupied by the original document.

25 If the user selects to make a local copy and subsequently merge the changes, the local copy will be made and the path of the original document will be stored so that the original document location can be determined at the time that the changes are merged. If the local copy of the document is closed without any changes, the local copy is simply discarded. If, on the other hand, the user selects to save changes to the local copy of the document, a determination will be made as to whether the original document is still in use. If the original document is not in use, then the user will be notified that the original document is available.

30 If the original document is available, the user will be able to select whether to merge the user's changes into the original document. If the user selects to merge the user's changes into the original document, then the original

document is opened and the changes are merged. The original document is located using the original path that was stored when the local copy was created. At this point, the local copy is closed (and discarded) and focus is transferred to the original document.

5           If, when the user selected to save changes to the local copy, a determination is made that the original document is still in use, the user will be presented with an alert that notifies the user that original document is still in use. The user will be allowed to select between saving the local copy as a separate file and canceling the save instruction. If the user selects to save the local copy then  
10   the document is saved. When the document is saved, it is saved with a property that stores the path of the original document with the saved local document. The user may subsequently choose to merge the local document with the original document. In this case, the merge procedure will find the path to the original document that was stored with the local document and a merge will be attempted  
15   to save the differences between the local document and the original document.

          In another aspect of the invention, any time that a merge is attempted, and a conflict exists (e.g., the changes in the local document are inconsistent with the changes made to the original document), an alert can be generated to inform the user of the conflict and the user can be prompted to  
20   reconcile the conflict. In this aspect of the present invention, a prompt can be provided to the user when the original document is still in use and the user seeks to save the user's changes to the original document. The prompt could enable the user to send the changes in the local copy via email to a recipient. When the recipient receives the local copy via email, the recipient may then merge the local  
25   copy with the original document. The path of the original document may be saved with the local copy so that the recipient would be notified of the original document to which the changes were intended to be made.

#### BRIEF DESCRIPTION OF THE DRAWINGS

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Fig. 1 is a block diagram of a computer system that provides the operating environment for an exemplary embodiment of the present invention.

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Fig. 2a is a block diagram depicting an exemplary server arrangement in which multiple users have access to a single document.

Fig. 2b is a block diagram depicting an exemplary server arrangement in which multiple users have restricted access to a single document.

5 Fig. 3 is a block diagram depicting the primary components of an exemplary embodiment of the present invention.

Figs. 4a and 4b are parts of a single flowchart depicting a method for enabling simultaneous multi-user editing in an exemplary embodiment of the present invention.

10 Fig. 5 is a flowchart depicting a method for enabling the subsequent merging of changes made by a user in an exemplary embodiment of the present invention.

15 Fig. 6 is a flowchart depicting a method for merging changes into an original document when a user attempts to open a local copy of that original document in an exemplary embodiment of the present invention.

## DETAILED DESCRIPTION

20 When a user of an embodiment of the present invention attempts to open an original document, a determination is made as to whether the original document is in use by another user. If the original document is not in use by another user, the document is opened and the user may edit the document in the conventional manner.

25 If a determination is made that the document is in use, then an alert is presented to the user that informs the user that the document is locked for editing. The alert will also provide the user with three options. The user may select to open the document as a "read only" document. The user may select to open a document as a "local copy" and subsequently merge any changes into the original document. Finally, the user may select to receive a notification when the  
30 original document is no longer in use. If the user selects the first option, a read-only version of the document will be provided and the user may save the

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## An Exemplary Operating Environment

Fig. 1 and the following discussion are intended to provide a brief, general description of a suitable computing environment in which the invention may be implemented. While the invention will be described in the general context of an application program that runs on an operating system in conjunction with a personal computer, those skilled in the art will recognize that the invention also may be implemented in combination with other program modules. Generally, program modules include routines, programs, components, data structures, etc. that perform particular tasks or implement particular abstract data types. Moreover, those skilled in the art will appreciate that the invention may be practiced with other computer system configurations, including hand-held devices, multiprocessor systems, microprocessor-based or programmable consumer electronics, minicomputers, mainframe computers, and the like. The invention may also be practiced in distributed computing environments where tasks are performed by remote processing devices that are linked through a communications network. In a distributed computing environment, program modules may be located in both local and remote memory storage devices.

With reference to Fig. 1, an exemplary system for implementing the invention includes a conventional personal computer **20**, including a processing unit **21**, a system memory **22**, and a system bus **23** that couples the system memory to the processing unit **21**. The system memory **22** includes read only memory (ROM) **24** and random access memory (RAM) **25**. A basic input/output system **26** (BIOS), containing the basic routines that help to transfer information between elements within the personal computer **20**, such as during start-up, is stored in ROM **24**. The personal computer **20** further includes a hard disk drive **27**, a magnetic disk drive **28**, e.g., to read from or write to a removable disk **29**, and an optical disk drive **30**, e.g., for reading a CD-ROM disk **31** or to read from or write to other optical media. The hard disk drive **27**, magnetic disk drive **28**, and optical disk drive **30** are connected to the system bus **23** by a hard disk drive interface **32**, a magnetic disk drive interface **33**, and an optical drive interface **34**, respectively. The drives and their associated computer-readable

media provide nonvolatile storage for the personal computer **20**. Although the description of computer-readable media above refers to a hard disk, a removable magnetic disk and a CD-ROM disk, it should be appreciated by those skilled in the art that other types of media which are readable by a computer, such as magnetic cassettes, flash memory cards, digital video disks, Bernoulli cartridges, and the like, may also be used in the exemplary operating environment.

A number of program modules may be stored in the drives and RAM **25**, including an operating system **35**, one or more document editor application programs **36**, server access program module **38** for providing access to a remote file server, and any number of documents **39a**. A user may enter commands and information into the personal computer **20** through a keyboard **40** and pointing device, such as a mouse **42**. Other input devices (not shown) may include a microphone, joystick, game pad, satellite dish, scanner, or the like. These and other input devices are often connected to the processing unit **21** through a serial port interface **46** that is coupled to the system bus, but may be connected by other interfaces, such as a game port or a universal serial bus (USB). A monitor **47** or other type of display device is also connected to the system bus **23** via an interface, such as a video adapter **48**. In addition to the monitor, personal computers typically include other peripheral output devices (not shown), such as speakers or printers.

The personal computer **20** may operate in a networked environment using logical connections to one or more remote computers, such as a remote computer **49**. The remote computer **49** may be a server, a router, a peer device or other common network node, and typically includes many or all of the elements described relative to the personal computer **20**, although only a memory storage device **50** has been illustrated in Figure 1. In Figure 1, the remote computer **49** is a server that is controlled by a file server program module **37** and maintains original document **39b**. The logical connections depicted in Figure 1 include a local area network (LAN) **51** and a wide area network (WAN) **52**. Such networking environments are commonplace in offices, enterprise-wide computer networks, intranets and the Internet.



When used in a LAN networking environment, the personal computer **20** is connected to the LAN **51** through a network interface **53**. When used in a WAN networking environment, the personal computer **20** typically includes a modem **54** or other means for establishing communications over the WAN **52**, such as the Internet. The modem **54**, which may be internal or external, is connected to the system bus **23** via the serial port interface **46**. In a networked environment, program modules depicted relative to the personal computer **20**, or portions thereof, may be stored in the remote memory storage device. It will be appreciated that the network connections shown are exemplary and other means of establishing a communications link between the computers may be used.

An exemplary embodiment of the present invention is represented by the "MICROSOFT WORD" word processing application program, the "MICROSOFT EXCEL" spreadsheet application program, the "MICROSOFT ACCESS" database application program, and the "MICROSOFT POWERPOINT" graphical presentation application program. However, it should be understood that the present invention can be implemented by various program modules and/or application programs for use with various operating systems.

#### A Conventional File Server System

Fig. 2a depicts a conventional file server system in which USER A **206**, USER B **212**, USER C **214** and USER D **216** are connected to file server **202** over a network connection. All users have access to an original document **204** on the file server **202**. However, access to the original document must be limited to the extent that multiple simultaneous modifications of the original document can create conflicts.

Conflicts occur when two or more users attempt to make inconsistent modifications to the same document. For example, USER A **206** may wish to replace a sentence in the original document **204**, while USER B **212** wishes to delete the sentence entirely. Various known methods exist for resolving conflicts by prompting one or both users to select the effective change. However, because conflicts can occur, modifications to a document must be limited so that

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Access to an original document can be limited in various ways. One approach has been to use a document editor to limit access to an original document. In this approach, the first user to access the original document has unlimited access thereto. In the case of Fig. 2a, USER A **206** has obtained original document access **210** and is editing the original document with document editor **208**. Document editor **208** will temporarily mark original document **204** with a flag that indicates that the document is in use. If other users were to attempt to access the original document using a compatible document editor, the flag would be recognized and the other user's document editor would limit the user's access to the original document. Typically, the user's access would be limited by either prohibiting the user to access the document at all or by forcing the user to open a local copy of the document. A local copy of the document is an entirely new document and cannot be saved to the path of the original document while that document is still open. By forcing the creation of a local copy, the original document cannot be edited by two users simultaneously. Accordingly, as is depicted in Fig. 2a, USER B, USER C and USER D have local copies of original document **204**.

Turning now to Fig. 2b, another conventional file server system is depicted in which simultaneous multi-user document editing is enabled. In the system of Fig. 2b, the file server **202** has two sub-units: access monitor **260** and document repository **262**. The original document **204** and all other documents are

stored within document repository **262**. All access to any documents within document repository **262** is monitored and controlled by access monitor **260**. Accordingly, if any one of USERS A-D attempts to open original document **204** the access monitor will allow the user to make a copy of the original document and all editing done by the user will be made to the copy. Each user attempting to access the original document **204** is provided with a unique copy and the access monitor **260** maintains a record of which copy was assigned to each user.

When a user that has been assigned a copy of the original document attempts to save the changes that the user has made to the assigned copy, the access monitor **260** determines that the changes made to the copy are intended to be merged into the original document **204**. The access monitor **260** will then perform the merge and the changes that USER A made to its copy will be merged into the original document **204** and the document repository **262**. If USER B, for example, attempts to save its changes to its assigned copy, the access monitor will then attempt to merge those changes into the original document **204**. Should any conflicts exist between the changes of USER A and the changes of USER B, the access monitor can notify the users of this conflict and prompt the users to reconcile the conflict.

In essence, the access monitor serves as a means for checking in and checking out documents for modification. Because it maintains records of all document checkouts, and tightly controls all attempts at original document modification (i.e., merges), the system depicted in Fig. 2b enables very effective simultaneous multi-user editing of original documents. However, the system of Fig. 2b requires expensive software and is consumptive of server system resources. The system also creates inefficiencies as all users must access the access monitor prior to being permitted access to a document in document repository **262**.

A third approach to enable simultaneous multi-user document editing is to utilize an entirely different file format. For example, the MICROSOFT EXCEL spreadsheet program marketed by Microsoft Corporation utilizes a "shared work book" format that that supports simultaneous multi-user

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editing. However, such file formats often have limited functionality and are often not compatible with earlier non-multi-user file formats.

#### An Exemplary System For Simultaneous Multi-User Document Editing

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Turning now to Fig. 3, a system is depicted in which simultaneous multi-user document editing is simply and effectively enabled. Notably, file server **202** does not have a document repository or access monitor as described in connection with Fig. 2b. In this system, the user that first attempts to access the original document **204** is provided with unlimited original document access **310**. In the example of Fig. 3, USER A accessed original document **204** before USERS B-D and, accordingly, was provided original document access **310**. USER A's document editor **318** can mark original document **204** with a flag that indicates to subsequent users that another user (USER A) is accessing original document **204**.

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Because USER A has original document access **310**, USER B will be notified that the original document **204** is in use by USER A, when USER B attempts to open the original document **204**. In this case, USER B will be permitted to open a local copy **312**. USER B's document editor **323** can maintain the path of original document **204**. Accordingly, any subsequent merge of the changes to local copy **312** can be performed on the original document **204**, because the location of the original document is maintained by document editor **320** in connection with local copy **312**. When USER B is finished making changes to local copy **312**, USER B can elect to save the changes to the local copy or to the original document **204**. If the original document is still in use by USER A (or any other user), USER B may be prompted to choose whether to save the changes locally or to attempt a merge at a later time. This aspect of the present invention is described in more detail in connection with Figs. 4a and 4b.

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#### An Exemplary Method for Enabling Simultaneous Multi-User Document Editing

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Turning now to Figs. 4a and 4b, a flowchart is depicted which describes a method that is an exemplary embodiment of the present invention. In

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short, the method provides a means for enabling simultaneous multi-user document editing in a simple and effective manner that eliminates the need for sophisticated file servers (as depicted in Fig. 2b) or new file formats.

The method starts at step **400** and proceeds to step **402**. At step  
5 **402**, a user attempts to open an original document. The method then proceeds to decision block **404** in which a determination is made as to whether the original document is in use by another user. If the original document is not in use by another user, then the method branches to step **416** and the original document is simply opened. Because there is no potential for conflict among simultaneous  
10 editors in this case, the method proceeds to step **414** and ends.

Returning now to decision block **404** if a determination is made that the original document is in use by another user, the method branches to step **406**. At step **406**, the user is alerted that the original document is currently  
15 opened for editing by another user. The method then proceeds to step **408** and the user is prompted to select between three choices. The user may open a copy of the original document as a read-only copy. The user may also create a local copy for making modifications that may be subsequently merged with the original document. Finally, the user may elect to be notified when the original document becomes available. The method then proceeds to decision block **410** in which a  
20 determination is made as to whether the user selects to open a read-only copy of the original document. If the user selects this option, then the method branches to step **412**. At step **412**, a read-only copy is opened and the save command is disabled. The save command is disabled only to the extent that the read-only copy cannot be saved at the same path (i.e., location on the file server) as the  
25 original document. The method then branches to step **414** and ends.

Returning now to decision block **410**, if the user has not selected to open a read-only copy, then the method branches to decision block **418** and a determination is made as to whether the user has selected to be notified when the original document becomes available. If the user has selected to be so notified,  
30 then the method proceeds to step **420** and the original documents status is monitored and the user is notified when the original document is no longer being used. When so notified, the user may obtain access to the document and make

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modifications to the original document. The method then proceeds to step **414** and ends.

Returning now to decision block **418**, if the user has not selected to be notified of the original document's availability, then the user must have  
5 selected to create a local copy for subsequent merge. Accordingly the method branches to step **450** (Fig. 4b) via connector A **422**.

At step **450**, a local copy is created and opened and the path of the original document is stored in association with the local copy. The path of the original document may be stored in RAM, in non-volatile memory (e.g., a hard  
10 drive), in a system registry, or by any other conventional means of storing data. The method then proceeds to decision block **451** in which a determination is made as to whether the original document is still in use. If the original document is still in use then the method branches to step **452**. In decision block **452** a determination is made as to whether the user closes the local copy without making  
15 changes. If the user closes the local copy without making changes, then no subsequent merge is necessary and the method branches to step **454**. At step **454** a local copy is discarded. The method then proceeds to step **456** and ends.

If the determination in decision block **451** is that the original document is no longer in use, then the method branches to step **453**. At step **453**  
20 the user is alerted that the original document is available and the user is prompted to choose whether to merge the changes made to the local copy into the original document now or later. From step **453** the method proceeds to step **455** where a determination is made as to whether the user selects merge the changes now. If the user selects merge the changes now, then the method branches to step **472**.  
25 Otherwise, if the user selects merge the changes later, then the method returns to step **452**.

The method utilizes a background process that periodically determines whether the original document is available. This determination is performed independent of any action initiated by the user. This background  
30 process is illustrated by steps **451**, **453** and **455**. Although these steps are placed at a particular location in the flow chart of Fig. 4b, those skilled in the art will

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appreciate that the background process is running continuously and that steps **451**, **453** and **455** are merely exemplary steps illustrating the background process.

Returning now to decision block **452**, if the user has not selected to close the local copy without changes, then the method branches to decision block **458** in which a determination is made as to whether the user attempts to save the local copy. If the user does not attempt to save the local copy then the method branches to step **454** and the local copy is discarded. The method then branches to step **456** and ends.

If, on the other hand, at decision block **458** the user attempts to save the local copy, the method branches to decision block **460** wherein a determination is made as to whether the original document is still in use. If the original document is still in use, the method branches to step **462** and the user is alerted that the original document is still in use. The user is also prompted to select between saving the local copy as a local copy (i.e., with no effect on the original document) or to simply cancel the user's save command. The method then proceeds to decision block **464** wherein a determination is made as to whether the user selects to save the local copy. If the user selects to save the local copy then the method branches to step **466**. At step **466**, the local copy is saved in association with the path to the original document. The path to the original document is stored so that the user can perform a merge of the local copy with the original document at a later time. The method then proceeds to **476** and ends.

Returning now to decision block **464**, if a determination is made that the user does not select to save a local copy, then the method branches to step **474** through connectors **478**. At step **474**, the save command is cancelled. The method then branches to step **476** and ends.

Returning now to decision block **460**, if a determination is made that the original document is no longer in use, the method branches to step **468** and the user is notified that the original document is available. The user is also prompted to choose whether to merge the changes made to the local copy into the original document or to cancel the user's save command. The method then branches to decision block **470** in which a determination is made as to whether the user selects to merge its changes into the original document. If the user does not

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If, on the other hand, a determination is made at decision block **470** that the user desires to merge the changes into the original document, the method branches to step **472**. At step **472** the original document is opened and the changes are merged into the original document. The local copy can then be discarded and the user will have full access to the original document. The method then branches to step **476** and ends.

Fig. 5 depicts an alternate embodiment of the method of Figs. 4a and 4b. The alternate embodiment provides a means for emailing modifications made to an original document when the original document is in use by another user.

The alternate method proceeds from step **500** to step **502**. In step **502**, the user is alerted that the original document is still in use and is provided with three choices. As described in connection with step **462** (Fig. 4b), the user can select to save a local copy or cancel the save. However the alternate method provides the third choice of sending the changes to another user via email.

30           At step **508**, an email note is created and the local copy is attached in the conventional way as an attachment to the email note. The method then proceeds to step **510**. At step **510**, a default subject line can be inserted into the



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If, on the other hand, a determination is made at decision block **604** that the stored path flag is set, the method branches to **606**. At step **606**, the

If, on the other hand, a determination is made at decision block 604

stored original document path is retrieved and the method proceeds to decision block **608**. At decision block **608**, a determination is made as to whether the original document is being used by another user. If the original document is being used by another user then the method branches to step **610** and the user is notified that the original document is being used by another user. In this case, the method proceeds to step **620** and the local copy is opened, but no merging is done. The method then proceeds to step **622** and ends.

Returning to decision block **608**, if the original document is not in use by another user then the method branches to step **612** and prompts the user for authorization to merge local copy with the original document. The method then proceeds to decision block **618** and a determination is made as to whether the user has authorized a merge. If the user has authorized a merge, the method branches to step **616** and the changes are merged into the original document. The location of the original document is, of course, identified by the path that was stored in association with the local copy. The method then branches to step **614** and ends.

Returning now to decision block **618**, if the user does not authorize merging the changes into the original document, the method branches to step **620** and the local copy is simply opened. The method then branches to step **622** and ends.

The present invention has been described in relation to particular embodiments which are intended in all respects to be illustrative rather than restrictive. Alternative embodiments will become apparent to those skilled in the art to which the present invention pertains without departing from its spirit and scope. Accordingly, the scope of the present invention is defined by the appended claims rather than the foregoing description.

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